

WHAT IS CLAIMED IS:

1. An electron emission element comprising, a substrate, and a plurality of protrusions, composed of diamond, protruding from the substrate:

5 wherein each of the protrusions comprises,

a tip portion, having a sharp end, which is located at the top end of the protrusion, and

a columnar portion, the side face of which extends upward relative to the surface of the substrate, and which is located below the tip portion; and

10 wherein side face of each of the columnar portions of the protrusions is provided with a cathode electrode film, which is electrically connected to a conductive layer included in the protrusion.

15 2. The electron emission element according to claim 1, wherein the surface of the substrate and the side faces of the columnar portions form angles of not less than 78 degrees.

20 3. The electron emission element according to claim 1, wherein the surface of the substrate and the side faces of the columnar portions form substantial right angles.

25 4. The electron emission element according to claim 1, wherein the cathode electrode film covers both the protrusions and the surface of the substrate, and wherein the area of the portion of the cathode

electrode film that covers the surface of the substrate is larger than the area covering the protrusions.

5        5.    The electron emission element according to claim 1, wherein the cathode electrode film covers entire side faces of the columnar portions.

6.    The electron emission element according to claim 1, wherein at least part of the conductive layer is included in the tip portion.

10       7.    The electron emission element according to claim 1, wherein the conductive layer is formed by injecting metal ions into diamond.

8.    The electron emission element according to claim 1, wherein the conductive layer is composed of diamond containing impurities.

15       9.    The electron emission element according to claim 1,

         wherein the cathode electrode film comprises,

         a first cathode electrode layer that contacts the conductive layer, and

20       a second cathode electrode layer that is formed on the first cathode electrode layer and that is thicker than the first cathode layer.

25       10.   The electron emission element according to claim 1, wherein an insulation film is formed on the cathode electrode film, and wherein a second electrode film is formed on the insulation film.